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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/728,948	12/08/2003	Byung Hyun Jung	040044-0307076	8998
909	7590	01/27/2005	EXAMINER	
PILLSBURY WINTHROP, LLP			LUU, CHUONG A	
P.O. BOX 10500			ART UNIT	
MCLEAN, VA 22102			PAPER NUMBER	
			2818	

DATE MAILED: 01/27/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

GA

<b>Office Action Summary</b>	<b>Application No.</b> 10/728,948	<b>Applicant(s)</b> JUNG ET AL.	
	<b>Examiner</b> Chuong A Luu	<b>Art Unit</b> 2825	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4, 6, and 12 is/are rejected.
- 7) ☒ Claim(s) 5,7-11 and 13-16 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>12/08/2003</u> . | 6) <input type="checkbox"/> Other: ____.  |

**DETAILED ACTION**  
**PRIOR ART REJECTIONS**

**Statutory Basis**

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**The Rejections**

Claims 1-2, 4, and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu et al. (U.S. 20040087136 A1) in view of Choi et al. (U.S. 20030219979 A1).

Wu discloses a method of forming a barrier layer with

(1) forming an insulating layer (2) on a semiconductor substrate (1);

forming a contact hole (3) on the insulating layer (2);

depositing a barrier metal (4) in the contact hole (3) and on the insulating layer

(2) using an atomic layer deposition process (see paragraph [0014]);

depositing a tungsten layer (5) on the barrier metal (4) using the atomic layer deposition process (see paragraph [0015]);

(2) wherein the atomic layer deposition process for the barrier metal and the tungsten layer is performed in a two step deposition "in a single reaction chamber" (see paragraph [0015]).

Wu teaches the outlined features above except for filling the contact hole with a tungsten; wherein the tungsten is deposited by chemical vapor deposition; wherein the tungsten layer is deposited at a temperature of 200°C to 600°C;. However, Choi discloses a method a metal layer with **(1)**... filling the contact hole with a tungsten (see paragraph [0058]. Figure 6C); **(4)** wherein the tungsten is deposited by chemical vapor deposition (see paragraph [0059]); **(12)** wherein the tungsten layer is deposited at a temperature of 100°C to about 650°C “200 to 600°C” (see paragraph [0012]). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the teaching of Wu (accordance with the teaching of Choi) by selecting tungsten as an interconnect material since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice, and it also has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art and it is noted that the applicant does not disclose criticality in the ranges claimed. In re Leshin, 125 USPQ 416 and In re Aller, 105 USPQ 233 (see MPEP 2144.05). Doing so would facilitate the manufacture of the semiconductor device and improve the conductivity of the interconnect structure.

Claims 3, and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu et al. (U.S. 20040087136 A1) in view of Choi et al. (U.S. 20030219979 A1) and further in view of Leu et al. (U.S. 6,605,874 B2).

Wu and Choi teach everything above except for wherein the barrier metal is WSiN layer; wherein the WSiN layer has a thickness of 20 to 100Å. Furthermore, Leu discloses a method of making semiconductor device with (3) wherein the barrier metal is WSiN layer (see column 3, lines 66-67 and column 4, lines 1-8); (6) wherein the WSiN layer has a thickness of 100 Å to 500 Å "20 Å to 100Å" (see column 3, lines 61-63). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the teachings of Wu and Choi (accordance with the teaching of Leu) by selecting tungsten nitride as barrier material since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice, and it also has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art and it is noted that the applicant does not disclose criticality in the ranges claimed. In re Leshin, 125 USPQ 416 and In re Aller, 105 USPQ 233 (see MPEP 2144.05). Doing so would facilitate the manufacture of the semiconductor device and improve adhesive and conductive diffusion barrier qualities.

***Allowable Subject Matter***

Claims 5, 7-11, and 13-16 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chuong A Luu whose telephone number is (571) 272-1902. The examiner can normally be reached on M-F (6:15-2:45).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Chuong Anh Luu  
Examiner  
January 10, 2005